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ABSTRACT

An approach is described for teaching undergraduate sociology students social research skills through student use of packaged computer programs while carrying out their own research projects. Two back-to-back courses focus on training in data collection methodologies, followed by training in data analysis using the computer. In order to meet the needs for accurate information in future decision making, it is strongly suggested that additional social research electives be offered on a regular basis. Given the present level of computer technology and the cautious addition of methodological innovation and training, we can expect a surge in the rate and quality of functional information which sociologists can provide for those in positions of authority. (Author/CHV)

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EFFECTIVELY TEACHING UNDERGRADUATE SOCIAL RESEARCH VIA COMPUTER DATA ANALYSIS

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Effectively Teaching Undergraduate Social Research Via Computer Data Analysis

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Introduction

History will no doubt record along with her most hallowed inventors the names of Charles Babbage, George Hollerinth, Howard Aiken, Konrad Zuse, and later visionary wizards who contributed importantly toward the conceptualization of what has become our modern computer era (Brier and Robinson, 1973). And rightfully so! Our space-age techno ogy is recognized as being increasingly dependent on this electronic marvel.

The rapidly expanding usage of computer programs, especially "packaged" subprograms, has also given the social scientists capabilities that few of them dreamed possible even a decade ago. While tremendous strides have been made *technologically* with respect to efficiently handling and modifying social data, there exists still a lag in training a sufficient number of social scientists to competently use these apparati with a maximal degree of effectiveness. It is upon this latter premise that this paper is based.

A rather unique approach designed to interest and assist undergraduate sociologists in learning what has been previously regarded as "advanced" methodologies is described below. A number of innovations which have made practical the use of computers as very effective learning tools for undergraduate social scientists, especially sociology students, are also discussed.

Prior to describing these strategies involving the computer, it seems appropriate to introduce the rationale for the need for greater emphasis on undergraduate social research.

Undergraduate "Hard Sciences" and "Social Sciences:" The Methodological Emphasis Gap

When one compares the relative emphasis given to undergraduate empirical research methods courses for some of the so-called "hard sciences" to those of the "social sciences," the methodological "gap" becomes apparent. These comparisons are easily gleaned in Table 1.

When the totals of the four research courses in the "hard" and "social" sciences are compared, 33.5 percent compared to 12.5 percent of the above total course curricula are methodologically oriented within the "hard" and the "social" sciences, respectively. Clearly more than twice as much emphasis is placed on "methods" within the "hard sciences" compared to the "social sciences," at least on the basis of the relative proportion of methods courses offered within each of the above departments.[2]

A very defendable argument could also be generated to the effect that the research methodology in the "social sciences" is in many aspects just as difficult, if not more difficult, to learn and to teach as are the methodologies in the "hard sciences." For example, human subjects often react differently when they know they are being observed (e.g., the "guinea pig" phenomenon). Furthermore, human subjects have a multitude of

Table 1. Comparison of Percent of Research Methods Courses Offered to Total Courses Offered by Four Major Departments in "Hard Sciences" and i he "Social Sciences"[a]

	Hard Sciences				*Social Sciences*			
	Biology	Botany	Chemistry	Physics	Political Science	Sociology	Communi-cation	Psychology
Percent Methods Courses Offered	27%	34%	36%	37%	6%	11%	12%	21%
Total No. Courses Offered	24	16	39	34	50	56	36	35

[a]These figures are approximations for it was not always possible to ascertain the precise proportion devoted to methodology of some lecture/lab type courses. Nonetheless, the comparisons are all based on clearly identifiable methodological [illegible] each particular major. These figures are based on the data in the *Florida Technological University 1975-76 Catalogue.*

stimuli impinging upon their subjective attitudes and public behaviors. Laboratory experiments are quite artificial settings for humans, making the generalization of findings very difficult (Smith, 1975; Babbie, 1975). While the "which is the most difficult" argument could never be resolved to everyone's satisfaction, the fact remains that the methodologies necessary for quality social research *are* very complex. Yet 22 percent of the universities and 38 percent of the four-year colleges do not presently offer even a *single* course in undergraduate research methods.[3] From our own experience we are convinced that most students need additional as well as more effective training than they now generally receive if they are in fact going to become active social scientists. With so little emphasis, it is understandable but sad to note that many of our bachelor degree students cannot even adequately read their professional journals.

The Need for Greater Emphasis on Undergraduate Social Research Methods

Let us now focus on undergraduate social research methods. Largely due to recent, sophisticated computerized statistical packages such as SPSS (Nie et al., 1975), sociology now has within its grasp the potential for contributing much more and, importantly, much better quality information that is sorely needed within both the governmental and private sectors. Given these relatively new and far more pragmatic electronic capabilities, sociologists can now work much more effectively with multivariate analysis techniques on complex sets of data. "Path" models illustrating the complex ways that variables work through and with other variables are now feasible. Not only can we study and understand complex social processes more readily, we can now more accurately evaluate and predict their magnitude and direction due to various changes in social structures of society and social organization. Furthermore, new and improved computer subprograms are being developed jointly by computer specialists, statisticians, and social researchers. In that other social sciences disciplines are not as concerned with complex sets of data (i.e., utilizing numerous variables), sociology in particular now has a very marketable product even though its full potential is just beginning to be realized. As a discipline we are on the brink of being recognized as a major contributor of useful types of information that have been lacking when important decisions have been considered. We must now alert industrial, business, and governmental sectors of our greatly improved capabilities. It's time they learn what sociologists can now do for them.

The wider utilization of sociological methodologies means not only can sociology make important contributions to society and to its social organizations but also that research oriented sociology students are going to be in far greater demand as this poten-

tial is realized. If one factor were to be singled out as largely responsible for the bright future of sociology, it would be the recent development of relatively easy to learn and use packaged computer programs which allow us to handle complex sets of data with far greater efficacy.

The foregoing is not to say that social data are now, ever were, or ever will be, precise. Social data are not, never have been, and probably never will be *precise* . Nonetheless, sociological data *are useful* now, and the data will become more and more useful as we train more and better research sociologists in advanced areas of computerized, statistical technologies. Fully learning and understanding how to work with such interrelated variables requires numerous methodological and statistical courses, some of which need to be oriented around computer skills. In addition, students need a great deal of actual practice in *doing* research. It is our firm belief that we need to vastly upgrade the statistical and methodological curriculum within undergraduate sociology departments to meet the growing demand for our unique, much-needed product. While the cost of becoming a social methodologist will be higher, the caliber of our product will increase accordingly.

We should note, however, that only a relatively small proportion of sociology students usually wish to enter seriously into the social research aspects of sociology; most students have preferred substantive or theoretical interests. As Blalock (1975) pointed out, we need such a division of labor within sociology. However, methodologists need to be better trained to better carry out their specialized functions. We may do well in sociology to challenge and recruit the best (in terms of mathematically, "scientifically" inclined students) high school students to enter sociology and become social researchers. By training undergraduates with real research interests in more advance methodologies, these students can enter graduate school much better prepared to truly achieve sophistication in social research even at the master's level.

Strategy for Teaching Undergraduate Social Research

In an effort to upgrade our FTU undergraduate program with respect to social research emphasis, we have developed two back-to-back courses, "Data Collection Methodology" and "Data Analysis." The content and rationale for each of these courses are discussed in some detail below, although we shall here focus largely on "Data Analysis" since this course is designed around the use of the computer as a skill and, even more importantly, as a tool.

First Quarter: "Data Collection Methodology"

During the first course, students learn the basic techniques necessary to collect valid information for subsequent analysis. After all, a scientist's data must be based on valid information or data analysis is futile. As noted earlier, we cannot often measure social phenomena perfectly; however, we can and do measure social indicators so as to allow these data to provide very useful information and guidelines. Proper training in these methodologies is essential.

In addition to studying the basic methodological principles involved in collecting reliable information with care being given to learning to avoid numerous sources of error, the students study various sampling techniques and strategies, the appropriateness of available research designs, as well as the close relationship between theory and research. They also learn what mode, or combination of modes, of data collection are most appropriate for each particular research problem.

For example, the students study the advantages and disadvantages of interview schedules, survey questionnaires, laboratory and field experimental techniques, working with documents, content analysis, participant observation, and using unobtrusive data collection techniques. However, since questionnaires are by far the most commonly used (and also least expensive means) of collecting data we focus much more on this mode.

The Key to Learning Research: Involvement

Fairly early in the quarter, students (usually about twenty-five per section) are asked to divide into teams of two to four compatible members and then carefully select a topic of research that they *want* to study. Example topics which students have previously selected include: "Suicidal Tendencies Among College-Age Students," "Determinants of Students' Perceptions of Police Officers," "The Interaction Between 'Severity of Punishment' and 'Certainty of Punishment' as Crime Deterrents," "Changes in Touching Taboos," "Crying and Sex Roles," "Singles' Battles in Today's World," "Predictors of Marijuana Usage and Discontinuance," "The Bar Room and Social Behavior," "Sexual Attitudes and Behaviors," and "Alternatives to Referendums at the Polls."

Once the general topic is agreed upon, each team of students must write a proposal to study this topic. The proposal entails writing an introductory section that justifies the need for information on the topic, its importance, and the broader aspects of the topic. Via a division of labor, each team then searches the professional literature for empirical and theoretical studies that relate to its area of interest. The students learn to summarize others' findings in a clear, concise manner.

From its literature search, as well as from logic, each team must formulate and justify a number of hypotheses about its topic. The students must also list all other "test" variables they can justify for inclusion in their study. Learning to master these conceptual skills is crucial in order to provide direction in the subsequent data collection and data analysis procedures.[4]

Finally, the teams must present a section concerned with their proposed methodologies for collecting the data. These proposals are returned along with suggestions which can help the students avoid serious errors in their research design. We might add that having (fewer) teams rather than many individuals with whom to work enables the instructor to give the teams more feedback and individual assistance. More important, the team approach enables the students to learn from each other, motivate each other, and also to divide some of the work among themselves.

Questionnaire Construction and Administration

Next, each team constructs a questionnaire designed to operationalize each variable in their hypotheses as well as the "test" factors they wish to include in their study. These questionnaires are pretested by fellow students and submitted to the instructor for any additional clarification that may be needed. Importantly, the students learn during this process to "precode" their question items for subsequent computer usage. At last, the students are ready to actually collect data. . . data in which they have become quite involved, interested, and curious.

At this point we should mention a compromise in sampling techniques that is necessitated by the time frame in which we must work. Collecting data from even a random sample of students or classes of students is a major undertaking, to say nothing of coordinating the efforts of eight or so teams, getting permission to survey classes, etc. For this reason we only survey our own research classes (and occasionally an additional sociology class). While this is not the ideal in terms of representativeness or in terms of having a larger number of cases, it *is* practical and has some advantages. Besides efficacy, students see how their fellow students have formulated their questionnaires. This leads to interesting discussions concerning the rationale and justification concerning many question items.

This approach also allows us to develop a *single* questionnaire, which includes *all* the demographic question items needed by the various teams, rather than include such variables in each separate questionnaire. In fact, the students learn to write and read coding instructions during this process. Each student then key punches his own demographic questionnaire and duplicates this IBM card for each student in the class. It is important for validity purposes that the students learn to administer the questionnaires, including

the demographic questionnaires, in such a manner that the students know their responses are completely anonymous. Eventually, the demographic cards are matched with each student's questionnaire via a code number known only to the individual student.

Through these procedures the students have data from their well-constructed questionnaires in hand by the end of the first quarter. They also learn to code and keypunch data so that the second quarter can be devoted to learning the skills necessary to use the computer as a tool in learning to analyze their data.

Second Quarter: "Data Analysis"

At the onset of the second quarter, the students learn to keypunch the raw data from their questionnnaires. They must also learn the deck set-up formats as a starting point for subsequent computer programs.[5] Learning computer skills can indeed occupy a full quarter in-and-of itself. Two major breakthroughs have allowed students to learn the necessary deck set-up and data modification procedures, as well as commonly used statistical subprograms. First, efficient and relatively easy to learn and use statistical packages have been developed for the social sciences (e.g., Nie, et al., 1975). Numerous pre-programmed subroutines provide a great deal of standardization necessary in order to teach and learn computer skills efficiently; yet, the necessary flexibility for analysis of the data is easily incorporated into the program design. As noted previously these advances along with concurrent advances in computer technology have given sociology a tremendous thrust forward.

Computer Printout Guide

Secondly, we have developed for this second course a format that enables the student to learn to use these skills much more readily. A condensed version of a recent "Student Study" of students' needs and values (Brown and McQuilkin, 1975) is used to illustrate the step-by-step process the students can follow, to a large degree, by simply plugging their own data into these illustrated steps.

In actuality, each student is given a computer printout which illustrates each step of the deck set-up of the data necessary for the student to get his data on the computer. These printouts illustrate necessary job control language cards, a variable list format, an input format for reading the raw data, variable and value labeling procedures, handling missing data procedures, various data modification techniques, index construction formats, and other optional tasks. In addition, "comment" cards which explain each step are included in the computer printouts.[5]

Of course these printouts are discussed in detail in class. Since the students are quite familiar with the "Student Study" questionnaire from first quarter discussions, they can more meaningfully follow their printout copies. Since each student has a printout before him or her, he or she can follow the discussion of each step, making additional marginal notes as needed. We have found that this "wholistic" or "A-to-Z," step-by-step approach greatly facilitates the students' learning to use the computer. Furthermore, it requires but minimal transfer by the student to insert his own data variables into this step-by-step guide. This latter process is, of course, what really reinforces the student for he or she is then actually *using* the computer on a set of his or her *own data* of interest. Again, team members teach each other and are able to reduce their work somewhat by a division of labor.

Learning Data Analysis Via the Computer

Perhaps the success of this approach is most obvious when an excited team of students proudly displays its first successful computer printout. Having (fewer) teams with which to work rather than numerous individuals enables the instructor to troubleshoot as the teams encounter errors in the process of learning these skills. It is important that the students receive sufficient assistance at this stage for even a simple error can create a great deal of frustration if the still novice students must find all their own errors.

Once the students have their own programs running and "cleaned," it is relatively simple for them to add new subprograms to their repertoire. Again, the example printout is a tremendous aid for the students not only see and study the actual program necessary to produce each procedure, but they can study brief examples of the computer output from each of these procedures. Since they have become familiar with the "Student Study" data, the output takes on much more meaning for them. Learning to analyze social data is quite difficult; therefore, having class discussions about what these output data are "saying" is most helpful. This approach gives the student examples and analytic principles he or she can apply to his or her own output.

Principal Statistical Procedures

The student's first computer subprogram is, of course, to output frequency distributions for all the variables in his questionnaire. Once obtained, the student learns to "read" his data with respect to understanding the appropriate measures of central tendency and dispersion as well as to interpret the frequency and percentage data. Generally the student must learn the rationale and techniques necessary to collapse some of his variables into fewer categories for crosstabular analysis. He also learns some basic ways to construct social indices for data reduction purposes.

Next the student learns to crosstabulate his or her data and, importantly, to "read" correctly the tables that are output. In addition, students learn to select appropriate measures of association for interpreting the relationships they are analyzing. As the student learns to use other subprograms (e.g., Pearsons correlations, non-parametric associative statistics, scattergrams), he or she is shown the correspondence between these various modes of data analysis.

Other subprogrammed statistical procedures the students learn involve a mean breakdown of dependent variables by the independent variables and tests for linearity for the relationships at hand. They also learn partial correlation subprograms, tests of significance such as t-tests and oneway analysis of variance. Importantly they learn what these subprograms can tell them about their study and, more specifically, about their hypotheses.

Other important aspects of using this computer approach in teaching social research methods include, in addition to learning valuable computer skills:

1. The approach permits a means by which more highly motivated students can go as far as they wish with additional computer subprograms and analyses. The text and the example printouts, together with some assistance from the instructor, allow motivated students to learn beyond what can be expected of the average student (e.g., basic modes of multiple regression analysis, two-way analysis of variance, factor analysis, etc.).

2. A great deal of flexibility is possible in terms of establishing criteria for grading the students' work. For example, one could apply a "contract" system allowing a student to earn the grade he or she desires by successfully running the computer subprograms and analysis presentation for which he or she "contracts."

3. Most importantly, the students gain a feeling of accomplishment as well as a sense of competence by learning "advanced" techniques in social research while still an undergraduate. Invariably, ten to twenty percent of the undergraduates follow these two courses with independent studies and/or become research assistants within the department. A gratifying by-product of this computerized teaching approach has been the high degree of success our research oriented students have had in obtaining hard-to-come-by financial assistance in major university graduate programs.

In sum, we have found that undergraduate students, given the short-cut learning aids described above, *can* learn the computer skills mentioned, and that using these skills is instrumental in learning how to effectively analyze and interpret data. Most students are challenged by this approach. The less ambitious students can "contract" for less stringent goals. These students, however, pick up

enough information to enable them to understand social data beyond what they could grasp by the simple textbook-lecture approach.

Data Presentation

In that this subject is in itself complex (and usually under-taught), it should be noted that students are expected to systematically present the findings from their computer analyses in a reasonably sophisticated report. Their earlier proposal, of course, serves as a starting point. Considerable assistance is given to the teams as they learn to systematically pull their findings together, for this too is a difficult skill to learn for the novice writer. The "Student Study" final report, on reserve in the library, offers an example with which the students can relate.

Summary

In brief, this paper has described a systematic approach for teaching undergraduate sociology students social research through student use of packaged computer programs while they carry out their own research projects. A number of schemes were described that enable this ambitious approach to lie within the bounds of practicality. As stressed early in the paper, the need for far greater emphasis on social research is growing. While it is not suggested that sociology departments mandate their undergraduate students to take more than three social research related courses, it is strongly suggested that, with the possible exception of small departments, additional social research electives be offered on a regular basis.

As a starting point, the data collection-computer data analysis approach as overviewed herein offers one workable alternative toward meeting the challenges that lie just ahead in sociology. Given our present level of computer technology, cautiously adding a touch of methodological innovation and training, we can indeed expect a surge in the rate and quality of functional information which sociologists can provide for those in positions of authority.

Notes

1. Correspondence with regard to the contents of this paper should be directed to Professor Cook.

2. While the data are based on FTU curricula, these proportions appear to be fairly typical of other universities. We make no attempt here to condemn or defend the reasons for these notable differences in research emphasis.

3. This finding was noted in an editorial article, "Undergraduate Sociology Curriculum Emphasizes 'Practical' Course," in *ASA Footnotes*, Vol. 3, No. 4 (April), 1975. The article was excerpted from a study by CRM Books. As might be expected, very few (2 percent) of the two-year colleges offer social research courses.

4. In addition to lectures and discussions on each area, the students have regular reading assignments in a methods text. *Strategies of Social Research: The Methodological Imagination*, by H. W. Smith, Prentice-Hall, 1975, is presently being used for the first quarter course.

5. The text for this course is *SPSS: Statistical Package for the Social Sciences*, Second Edition, by Norman Nie, et al., McGraw-Hill, 1975.

6. Copies of these printouts and the questionnaire are available from the authors.

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